Andrena marginata nigrescens Aurivillius (Sw. Gotländskt guldsandbi), a third subspecies of bee from Gotland (Hymenoptera, Apoidea, Andrenidae)

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This paper reports the discovery that the bee *Andrena marginata nigrescens* Aurivillius, 1903 is from the island of Gotland in the Baltic, NW Europe. A study of the literature and museum material as well as rediscovery of the bee in the field indicate that the type material collected by C.H. Boheman and described from the Swedish mountains was originally mislabelled. The type locality of the taxon is revised to Gotland. The characteristics of the subspecific bee include mainly brownish-black tergites and legs in both sexes. Many (c. 56%) of the females have two white spots on clypeus. The subspecies exhibits a general specialization on Dipsacaceae (*Scabiosa*, *Knautia*, *Succisa*) but *Scabiosa columbaria* may be its major food-plant. The subspecies *nigrescens* is the third bee taxon only known from Gotland, manifesting the island's isolation. The bee has only been recorded in a few places and to assess its conservation status is urgent.

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Introduction

The Eurasian solitary bee species *Andrena marginata* Fabricius, 1776 (Andrenidae) usually has an extensively orange abdomen and is therefore easy to recognize also in the field. However, the extent of orange varies and intraspecific taxa with brownish-black abdomen have been described. *Andrena marginata* var. *nigrescens* Aurivillius, 1903 was described from Swedish type material consisting of females collected by C.H. Boheman (Nilsson 2009). The original labels read "*Dlc. alp.*" (the montaneous part of Dalarna) and "*Itl.*" (Jämtland). There were also two specimens labelled "*Dv.*" (Dovre, Norway) and Aurivillius gave the geographic distribution of the bee as "*In alpibus Scandinaviae*". That *nigrescens* had not been recorded since Boheman's days while the nominate subspecies of *A. marginata* has an exclusive lowland distribution in Sweden were remarkable ingredients that made the case baffling (Nilsson 2009). Still, with both Boheman's three different original labels and Aurivillius's statement indicating a distribution and habitat in the Scandinavian mountains it had not been convincing at the time to challenge the correctness of the preexisting geographical information.

Since also the Dovre specimens offered an opportunity to explore the mysterious *nigrescens*, I asked Ø. Berg about further records of dark-coloured *A. marginata* from Norway. He informed that there were no such specimens in the Zoological Museum of Oslo, nor any known in Norway. He then drew my attention to the fact that there is questionable geographical information on

Figure 1. ***Andrena marginata nigrescens*** *Aurivillius from Gotland (left) and A.* ***marginata marginata*** *Fabricius from the Swedish mainland (right),* ♀ *and* ♂*. Size 9-10 mm. Photo: L.A. Nilsson.*

Gotländskt guldsandbi (vänster) och nominatunderarten av guldsandbi från svenska fastlandet (höger), ♀ *och* ♂*. Under mer än 100 år gjorde ursprunglig feletikettering att man ansåg den gotländska underarten tillhöra skandinaviska fjällen.*

certain diurnal Lepidoptera due to Boheman. I later contacted C. Eliasson who confirmed especially the case of the hesperiid butterfly *Pyrgus andromedae* (Wallengren, 1853). Indeed in this case too, type material collected by Boheman was labelled Dovre and montaneous Dalarna. But after the species description in 1853, the southernmost record of *P. andromedae* in Scandinavia is from northern Jämtland some 300 km away and it has been considered unprobable if the species occurs undiscovered in the southern mountains (Eliasson & al. 2005).

The information enforced my suspicion that Boheman's four dark bee specimens were drastically mislabelled. The type material of the butterfly *Pyrgus andromedae* constituted perhaps a parallel case. But if his specimens of the bee *A. m. nigrescens* were geographically mislabelled, what was their true origin? To tackle this issue, I examined the early written sources, regional records and geographical variation of *A. marginata*. I also attempted to get further clues on possible mislabelling from exploring Boheman's type material of *P. andromedae*.

Written evidence

In a study of Nordic bees at the Natural History Museum in Stockholm (NHRS), Nylander (1852a, paper submitted on 18 November 1850) was the first to mention that there was female

material of an *A. marginata* variant with dark-coloured tergites. But he did not indicate a locality (except understood Scandinavia). According to Norrlin (1913), Nylander visited Stockholm in August – early October 1850 as the first halt on a year-long trip to major European museums. Thus, by autumn 1850 the dark specimens *de facto* existed at NHRS. In his previous monographic treatment of the Nordic bee fauna, however, Nylander (1848, paper submitted on 6 December 1847) had not mentioned any dark females of *A. marginata* but many other bees collected by Boheman. Reasonably, therefore, the dark specimens had been obtained by the museum after 1847. During the three-summer interval, Boheman only went to Gotland for collecting, viz. both in 1848 and 1849 (Boheman 1850a, Stål 1873). Nylander (1852a, 1852b) mentioned in numerous later species accounts that he had studied various (other) bees collected on Gotland by Boheman.

Boheman (1850a, 1850b) wrote that he collected insects in many places on Gotland. His four female *nigrescens* specimens have quite unworn wing margins and no pollen load except scattered grains of *Knautia arvensis*, indicating that they had been captured during nectar-feeding prior to or early during the phase of establishing nests, thus in late July or early August (LAN pers. obs.). Since Boheman mainly focused on other groups than bees and *A. marginata* populations usually are strongly localized (LAN pers. obs.), the specimens were probably obtained on one occasion at a single locality. Places in late July – early August mentioned by Boheman reveal however no major candidate for a type locality. It is yet defining that both the dates and travels of Nylander and Boheman indicate that Gotland is the place of origin for the collected dark specimens. Accordingly, my next step was to explore records and comparative characteristics of undisputable material of *A. marginata* from Gotland.

Gotlandic history of *A. marginata* records

The early bee faunistic treatments, viz. by Nylander (1848, 1852b), Thomson (1872) and Aurivillius (1903), mentioned no presence of the species *A. marginata* on Gotland. Provincial presence was listed as late as by Svensson & al. (1990), who however did not provide any evidence. According to the recent survey of museum collections by the Swedish Species Information Centre (ArtDatabanken, SLU, Uppsala), the first specimen bearing a label indicating Gotland (as "Gl." in handwriting) is a female collected in August 1884 (leg. C.H. Nerén, det. L. Norén 2003 in coll. Nerén at NHRS, Reg beedata SE ArtDatabanken #14382). Nerén (1892) mentioned that he in 1884 had collected aculeates N of Hemse in the direction of Rone and Burs, parishes in the SE part of Gotland. But he did not mention the actual bee species or specimen. Any occurrence of *A. marginata* on Gotland was apparently unknown until Norén's species determination and label data report in 2003 to ArtDatabanken.

On 25 August 2009 a female of *A. marginata* (now in NHRS) visiting *Succisa pratensis* was collected in a moist meadow on Stora Karlsö (L. Norén and H. Bartsch pers. comm. in 2009 and 2010, respectively), a 2.35 km^2 calcareous rock plateau island 7 km off the W coast of Gotland. During 19-26 July 2010, I carried out an inventory of certain bee species in Gotland for the provincial authority (Länsstyrelsen). During this work I happened on 22 July to come across four gravelly localities with small numbers of both sexes of newly emerged *A. marginata* that visited the flowers of *Scabiosa columbaria* (one male was also seen on *Origanum vulgare*) in the Torsburgen area (Kräklingbo parish). It was perhaps much more than a coincidence, because it is known that Boheman collected insects such as the diurnal noctuid moth *Acontia* (now *Tyta*) *luctuosa* on the alvar at Kräklingbo (Wahlgren 1910). The male sex of the bee on Gotland could now be studied for the first time. Only a few days later, on 27 July 2010, a pair of *A. marginata* was collected on *S. columbaria* S of Visby (T. Ivarsson pers. comm.).

Variation in Gotlandic *A. marginata*

The colour characteristics of Boheman's four female specimens of *nigrescens* and the Gotland-labelled material are presented in Table 1. With but a single exception, all known males (N=4, and 2 more observed) and females (N=9, and 1 more observed) from Gotland are dark (Table 1, Fig. 1). "Dark" is defined as the central area of

the disc of tergite 2 being brownish-black (this spot seems to be the last to loose its orange in a gradation to mainly dark disc colour). Of the females, 5 (56%) have white spots on clypeus. In both sexes of non-aged specimens the legs are black (on the Swedish mainland the legs are more or less brownish). Gotlandic specimens also have a darker wing venation. They can be characterized as being generally darker. No difference was found between the male genitalia on Gotland and on the mainland. Of particular importance is that one of the two females I collected in 2010 had a pair of white spots on clypeus, just as the type material used by Aurivillius (for illustration of types, see Nilsson 2009).

Variation in other Nordic *A. marginata*

The Swedish non-Gotlandic material of *A. marginata* in NHRS (12♂♂44♀♀), the Zoological Museum in Lund (ZML, 23♂♂65♀♀), the Zoological Museum in Uppsala (ZMU, 3♂♂20♀♀) and my own collection (6♂♂4♀♀), altogether 177 specimens, exhibited a total of 3 (6.8%) and 1 (0.8%) dark-coloured males and females, respectively. Of the 133 females, 10 (7.5%) exhibited a white spotted clypeus and in addition there were some individuals with translucent or indistinct brownish-reddish spots. In fact, there was a transition between the presence of large spots (almost covering the lower half of clypeus) and indistinct spots, involving altogether some 15%

Table 1. Material and colouration of ***Andrena marginata nigrescens****. The table contains all voucher specimens known to the author by 2010-10-15.*

Materialet av gotländskt guldsandbi och dessa individers färgsättning. Tabellen omfattar alla de exemplar som var kända av författaren den 15 okt 2010.

Sex	Locality year/Legit	Tergites (T1-5)	Clypeus	Legs
♂	Hajdeby S 2010/LAN	Black with translucent brownish marginal zones	White (except a pair of dark triangular dots) with narrow black margin	Black
♂	Hajdeby S 2010/LAN	As above	As above	As above
♂	Torsburgen NW 2010/LAN	As above	As above	As above
♂	Visby S 2010/T. Ivarsson	As above	As above	As above
♀	"*Dlc. alp*." 1849/C.H. Boheman (Lectotype)	T1-3 brownish-black with orange marginal zone, T2-4 also with diffusely orange base	Pair of small pale spots (see Nilsson 2009)	Reddish- brown (aged)
♀	"*Itl*." 1849/C.H. Boheman (Paralectotype)♀	As above	Pair of large white spots (see Nilsson 2009)	As above
♀	"*Dv*." 1849/C.H. Boheman	As above	Pair of small white spots	As above
♀	"*Dv*." 1849/C.H. Boheman	As above	Pair of large white spots	As above
♀	Gotland 1884/C.H. Nerén	T1 black with orange marginal zone, T2 blackish on central area, T3-5 more blackish	Unspotted	Black
♀	Stora Karlsö 2009/ H. Bartsch	T1 black with orange marginal zone, T2-3 blackish on central area, T4-5 more blackish	Unspotted Unspotted	As above As above
♀	Hajdeby S 2010/LAN	As in the lectotype except T2-3 slightly more orange	Pair of small white spots	As above
♀	Torsburgen SE 2010/LAN	Very similar to the lectotype	Unspotted	As above
♀	Visby S 2010/T. Ivarsson	T1 black with orange marginal zone, T2 orange with black lateral spots, T3-4 orange, T5 blackish-brown	Unspotted	As above

of the individuals. No stylopization was found in the Swedish material. Furthermore, there was no apparent malformation in any of the white spotted individuals. The latter were scattered seemingly at random among localities and populations, and often collected on the same sites as individuals with spots.

Norwegian and Danish females are only known to have orange tergites (Ø. Berg pers. comm. 2008, H.B. Madsen pers. comm. 2010). Of 140 Finnish specimens of *A. marginata* in ZMH there are only 2 females and 5 males with dark tergites; the two females lack white spots on clypeus and are from localities where specimens with orange tergites have also been found; one of the dark females bears a label "v. *absoluta* Fr." (for a comment on this taxon, see below); 5 (6%) of 90 females but none of the dark ones from Finland and Russian Karelia have white spots on clypeus (J. Paukkunen pers. comm. 2010). Thus the proportion white spotted females is fairly low and about the same in Finland and mainland Sweden. Surprisingly, the presence of spots among "ordinary" females of this species seems not to have been mentioned in the literature or studied outside Fennoscandia (e.g. Stöckhert 1930, Dylewska 1987, Schmid-Egger & Scheuchl 1996, Gusenleitner & Schwarz 2002).

To summarize, only populations with a very high proportion of individuals with extensive orange markings on tergites as well as with females that exhibit infrequent spots on clypeus are found elsewhere in the Nordic area. This differs from the bee on Gotland, where nearly all individuals are dark and many of the females exhibit spots on clypeus.

Taxonomical remark

Occurrence of a dark abdomen in *A. marginata* has also been reported from other parts of the distribution of the species. Friese (1914) described *Andrena marginata* F. var. *absoluta* from material of both sexes collected in W Austria. The female was characterized by dark abdomen while no spots on clypeus were mentioned; the taxon probably does not represent a regional derivative in W Austria and is thus supposedly different from *nigrescens* and just a forma. In the British isles, females occur in three colour forms, two of which have a largely dark gaster; in one form the gaster is entirely dark (G. Else pers. comm. 2009). But, since these have evolved in another area than *nigrescens* they must be considered as possible other regional derivatives.

According to E. Scheuchl (pers. comm. 2010), among the more than 1100 palearctic *Andrena* species there are only 8 further species which females exhibit a clypeus with pale markings. In addition, he has seen such markings only occasionally in stylopized or gynandromorphic females of species in which the males have pale face markings. None of the Swedish specimens of *A. marginata* were found to be stylopized or strikingly malformed. Desease from external or internal (e.g. genetic from inbreeding) causes seems therefore not to be a factor explaining the bee *nigrescens*. More likely, it is a product of adaptive evolution under island isolation, i.e. a regional derivative. Although only a small number of individuals have been found 1884 - 2010, these bees provided the final piece of evidence that Gotland is the origin of Boheman's in 1848 or 1849 collected but gravely mislabelled bees that in 1903 became described as var. *nigrescens* by Aurivillius. The type locality is hereby revised (ICZN 1999 Article 76.A.2). The subspecific rank *Andrena marginata nigrescens* Aurivillius, as stated previously on quite different geographic information (Nilsson 2009), happens to be still justified.

Conservation status

The species *A. marginata* is nationally redlisted as VU, vulnerable (Gärdenfors & al. 2010). It is also included in a national action program underway for the conservation of bee species in meadows. The nominate subspecies *A. m. marginata* reaches northward to c. mid-Dalarna and northern Uppland, and exhibits a strongly fragmented distribution on the mainland (LAN unpubl. species facts profile). The conservation status of the subspecies *A. m. nigrescens* is virtually unknown, however. The very low number of individuals documented and observed since 1849 while many insect collectors have visited the island of Gotland suggests that the bee is rare and endangered. While the two previously known Gotlandic subspecies of bees *Megachile*

willughbiella janssoni Alfken, 1926 and *Bombus pascuorum gotlandicus* Erlandsson, 1953 are common and not threatened (LAN pers. obs.), the conservation status of *A. m. nigrescens* may deserve national as well as regional inventory priority. In particular for the sake of conservation, the vernacular name "gotländskt guldsandbi" is suggested.

Parallel mislabelling in *Pyrgus*?

Regarding the case of probable original mislabelling in the skipper butterfly *Pyrgus andromedae*, material of the presumed type series was found to be preserved both in NHRS and ZML. A ♂ in NHRS bears Boheman's original printed labelling "*Dv.*" and "*Bhn*.", and then "*andromedae Wgn. Mscpt*." (and on the underside "*centaureae*") in Wallengren's hand (B. Viklund pers. comm. 2010). Two ♀♀ in ZML lack Boheman's labelling but bear "*Dalecarlia Bohem*" respectively "*Dovre Bohem*" in Wallengren's hand (R. Danielsson pers. comm. 2010).

A straightforward conclusion is that Wallengren (1853) at least studied these three specimens, two of which were apparently *still unlabelled* when handed over by Boheman who thus provided any associated information by personal communication. Maybe Boheman's material had remained unlabelled for long, even a decade. Moreover, Opheim (1953) mentioned that Boheman included the three species *Pyrgus alveus* (Hübner, 1803), *P. andromedae* and *P. centaureae* (Rambur, 1839) in a single species with the epithet "*fritillum*". Probably Boheman mixed up the associated information of localities and biological observations among his material of *Pyrgus* (C. Eliasson pers. comm. 2010). Indeed, Boheman (1845) mentioned "*Hesperia fritillum*" from his trip to the Kvikkjokk mountains in Lule Lappmark 1843 which is perfectly within today's confirmed distribution of *P. andromedae*.

Clearly, circumstantial evidence suggests considerable mislabelling and misinformation risks and that the Kvikkjokk mountains are the strongest candidate for the true type locality of *P. andromedae*. It is beyond the scope of the present study, however, to find out exactly how mislabelling in Boheman's other insect material such as *Pyrgus* may be. Still, it is rather surprising that old mislabelling may to this day profoundly influence type localities and distribution records in butterflies, the group that attracts entomologists the most.

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Sammanfattning

Uppsatsen rapporterar att mysteriet med guldsandbiets mörka skandinaviska underart *Andrena marginata nigrescens* Aurivillius, 1903 nu lösts. Det visade sig att typmaterialet, som insamlats av C.H. Boheman strax innan 1850, är drastiskt feletiketterat. Etiketterna, vilka är av en tryckt standardtyp som introducerades under Bohemans tid på riksmuséet, bär namnförkortningar för utbredning i skandinaviens fjälltrakter. En rad bevis från tidpunkter för resor, publicering, utseende av senare påträffat material samt upptäckt och fältobservationer av nutida förekomster avslöjar överraskande emellertid att underarten är från Gotland. Typlokalen revideras till denna ö. Färgvariation redovisas och jämförande illustrationer ges för de således två underarterna av guldsandbi *A. marginata* som förekommer i Nordeuropa. *Andrena m. nigrescens* är det tredje kända unikt gotländska vildbiet, de två tidigare är gotlandshumla och gutetapetserarbi. Som svenskt namn föreslås **gotländskt guldsandbi**. Bevarandestatus hos gotländskt guldsandbi misstänks motivera särskilda åtgärder men återstår att undersöka. Arten *A. marginata* ingår i ett nationellt åtgärdsprogram för vildbin på ängsmark som håller på att tas fram (Östergötlands län).